prospectus, the work will be arranged according to subjects, and not alphabetically.

NOWHERE, according to Prof. Porter, President of Queen's College, Belfast, is the vital importance to the nation of technical education more keenly felt than amongst the merchants and manufacturers of Ulster. "Germany" (observes the same authority) "provides buildings, laboratories, and scientific apparatus on the most liberal scale. In France, Belgium, Switzerland, and the United States of America, higher technical education is making rapid strides under the fostering care of the respective Governments, aided by the generous contributions of patriotic citizens. The results of this wise liberality, while enriching those nations, are most seriously affecting the manufacturing interests of this country, and especially of Belfast and Ulster." Prof. Porter considers that in order fully to develop the latent resources of that part of Ireland we must have the means of giving young men a scientific training.

IN the *Bulletin* of the Essex (U.S.) Institute for April, May, and June is a paper by the Rev. G. F. Wright, on the Glacial Phenomena of North America, and their Relation to the question of Man's Antiquity in the Valley of the Delaware.

THE additions to the Zoological Society's Gardens during the past week include two Bonnet Monkeys (*Macacus radiatus*) from India, presented respectively by Mr. J. Thompson and Mr. C. Green; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. W. Thomson; a Banded Ichneumon (*Herpestes fasciatus*) from West Africa, presented by Mr. W. Cubitt; two Common Otters (*Lutra vulgaris*) from Ross-shire, N.B., presented by Mr. H. Mitchell; a Black-crested Eagle (*Lophoaëtus occipitalis*) from Africa, presented by Mr. E. A. Harland; a Brush Turkey (*Talegalla lathami*) from Australia, presented by Capt. F. M. Burke, s.s. *Cheybassa;* a Red-legged Partridge (*Caccabis rufa*), European, presented by Mr. J. E. Clayton; a Common Cuckoo (*Cuculus canorus*), British, presented by Master Alfred Beart; an American Black Bear (*Ursus americanus*) from North America, deposited; four Zebra Waxbills (*Estrelda subflava*) from Africa, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), three Undulated Grass Parrakeets (*Melopsittacus undulatus*), bred in the Gardens. The additions to the Insectarium include larvæ of the Comma Butterfly (*Vanessa C. album*), scarce Swallow-tail Butterfly (*Papilio podalirius*), and Privet Hawk-Moth (*Sphinx ligustri*). Also imagos of *Ranatra linearis*, and a specimen of *Attacus atlas* reared from larvæ hatched in the House.

OUR ASTRONOMICAL COLUMN

THE SATELLITES OF MARS.—The approaching opposition of this planet does not hold out much probability of satisfactory observations of the satellites except with the larger instruments, though in European latitudes the meridian altitude, which is an element in the case, will be considerable. Taking Prof. Asaph Hall's unit for brightness in 1877, viz. that on October 1, when the outer satellite was seen with the 9·6-inch equatorial of the Naval Observatory, Washington, we find the maximum brightness at the next opposition will be represented by 0·4, which is a less value than corresponds to the last date of observation with the 26-inch refractor at the same observatory. It may be remembered that Mr. Common observed *Deimos* on the morning of September 2, 1879, without much difficulty with his reflector of 3-feet aperture, when the degree of brightness in terms of Prof. Hall's unit was 0·50; at the last Washington observation in 1879 it was 0·52. The earth being only about 10° from the line of nodes of the satellites' orbits at the opposition in December next, their apparent paths are reduced almost to straight lines. The longitude of the ascending node of *Deimos* is 88°.

THE SATELLITES OF SATURN.—Mr. Marth has again prepared ephemerides of the five inner satellites of Saturn, which have been published in the *Astronomische Nachrichten*; he appends differences of right ascension between the outer satellite, *Japetus*, and the centre of Saturn, but he does not attack *Hyperion*. Preceding the ephemerides are auxiliary quantities for every fifth noon at Greenwich, by means of which the positions of the five inner satellites may be determined for any time required from the formulæ—

$$s \sin (p - P) = a \sin (l - L)$$
$$s \cos (p - P) = b \cos (l - L).$$

Here p is the angle of position with reference to the planet's centre, and s the distance therefrom; the values of $(l - L)$ and of the semi-axis a and b are tabulated for each satellite, as well as the angle P, which is applicable to all five. The process is simple enough to any one initiated in such calculations, but as there may be observers to whom they are unfamiliar, an example may not be out of place here.

Let it be required to determine from Mr. Marth's tables the angle of position and distance of *Mimas*, at Greenwich midnight, on October 1. We have then—

$(l - L)$ Oct. 1d. 0h. ...	287°·60	log a	+1·4856
Motion in 12h.	191°·04	sin $(l - L)$	+9·9433
$l - L$	118°·64	Call the sum A ...	+1·4289
From the tables: P =	359°·58	log b	−1·0128
a =	30″·59	cos $(l - L)$	−9·6806
b =	−10″·30	Call the sum B ...	+0·6934
		$\frac{A}{B} = \tan (p - P)$...	+0·7355
		$p - P$	79°·58
		Add p...	359°·58
		p	79°·16
		sin $(p - P)$	+9·9928
		$\frac{A}{\sin (p - P)}$	1·4361
		s	27″·30

THE FOURTH COMET OF 1874.—Dr. Holetschek, of the Observatory of Vienna, has investigated definitive elements of this comet, which was discovered on August 19, 1874, by M. Coggia at Marseilles. He uses four normal places: for August 21, September 18, October 10, and November 9. For the later normals we presume he will have made use of a fine series of observations made with Col. Tomline's 10-inch refractor at the Orwell Park Observatory, near Ipswich, by Mr. J. I. Plummer, which extends, we believe, considerably beyond observations published so far from other observatories. With Col. Tomline's refractor the comet was followed until the middle of November, and great care appears to have been taken with the observations and reductions. They form one of the very best series that has obtained for some years at an English observatory. Dr. Holetschek infers that the comet was moving in an elliptic orbit with a period of about 300 years. His orbit is as follows:—

Perihelion Passage, 1874, July 17·68463, Greenwich M.T.

Longitude of perihelion	5° 26′ 13″	M. Eq. 1874·0.
,, ascending node ...	215 50 47	
Inclination	34 7 54	
Excentricity	0·9622257	
Log. perihelion distance	0·227275	
Semi-axis major	44·671	
Period of revolution	...298·6 years.	

The comet with these elements might approach pretty near to the planet Uranus near the ascending node, but we might rather look to an encounter with Mars at the opposite node as the cause of ellipticity of orbit, the radii-vectores being there identical, with but small difference of latitude.

ANCIENT STAR-POSITIONS.—In the *Vierteljahrsschrift der Astronomische Gesellschaft*, 16 Jahrgang, Dr. O. Danckwortt has tabulated the positions of forty-six fundamental stars of the *Berliner Jahrbuch* for the commencement of each century from −2000 to +1800. He adopts Leverrier's precession constants for 1850, and takes account of the proper motions. The tables are preceded by a discussion of formulæ and comparison of constants which will be of service to any one who may have

occasion to carry back to a distant epoch the place of a star not included in Dr. Danckwortt's list. The values of the arcs A, A', and θ, are given for the beginning of every century within the above period. The place of the present Pole-star for the year −2000 is found to be R.A. 335° 10′ 0″, Decl. +67° 34′ 30″.

WE may mention that the formulæ for the reduction of the places of stars to distant epochs are investigated in a very interesting paper by Prof. Schjellerup, which Dr. Copeland and Mr. Dreyer have translated in No. 2 of *Copernicus*, and which the reader who desires to acquaint himself with the application of the rigorous method of taking account of precession should consult.

PHYSICAL NOTES

THE conducting power of metals for heat and electricity has lately occupied several physicists. Prof. Lorenz of Copenhagen, employing two methods (*Wied. Ann.*, Nos. 7 and 8), gets these results: (1) for the better conducting metals, a confirmation of Wiedemann and Franz's law, that the ratio of the two conductivities, both at 0° and at 100° is nearly constant; in the inferior conductors it increases much with decreasing conductivity; (2) in all metals except iron, the ratio $\frac{k_{100}}{\kappa_{100}} : \frac{k_0}{\kappa_0}$ is constant, and approximately equal to 1·367 (k and κ denoting the conductivities for heat and electricity respectively). Thus, for absolute temperature T, $\frac{k}{\kappa} = T \times$ constant.

A "MEDICAL hydrotelephone," contrived by Prof. Sabatucci (*Riv. Sci. Ind.*) is of the following nature:—Two lead cylinders (5 ctm. in diameter and ½ ctm. thick) are closed each with two very fine iron laminæ. To the anterior part of each is fitted a wooden mouthpiece (like that of a Bell telephone) connected to a caoutchouc tube, through which one may hear at a distance. The posterior part has a very sensitive electromagnet communicating with a microphone and battery. One tube is applied to either ear. Words or sounds produced before the microphone, and heard but faintly, are rendered intense and distinct by introducing liquid into the cylinders (the less dense the liquid the better). Two sounds may be compared, and their intensity exactly measured, by varying the quantity of the liquid and noting the effects through the tubes. Various applications of the apparatus, in clinical medicine especially, are looked for.

THE effects of lightning on trees placed near a telegraph wire are forcibly illustrated by phenomena lately observed by M. Montigny (*Bull. Belg. Acad.*, No. 7) on a portion of the road from Rochefort to Dinant; which runs from east to west, first on level ground and between poplars for about 1500 metres, then rises gradually 61 metres through woods to a wooded plateau some 200 metres in extent, then comes down to another plain. Of the poplars bordering the road on either side those on the north side, next the telegraph line, have largely suffered, 80 out of 500 having been struck, or about a sixth; those on the other side are very rarely struck. The plain presents only one case, and that doubtful. The instances multiply with increased elevation, and in the wooded plateau on the top reach a maximum (64 per cent.). The most violent discharges have been on the west side of the plateau and rising ground, which is generally first reached by the storms, and the injuries to trees are mostly opposite and under the level of the wire. M. Montigny supposes that while the wire is strongly electrified by induction, the lightning does not strike it, on account of its relative insulation, but strikes the neighbouring poplars directly, which, wet with rain, afford an easier passage for the electric fluid to the ground.

M. PICTET has examined seven varieties of steel (chiefly from a Sheffield and a Vienna house) with regard to magnetic power (*Arch. des Sciences*, August 15). This power he finds to depend on the presence of carbon in the iron, and the aggregation of these substances. One of the two steels giving the best results had ⅞th per cent. of carbon. Samples with 1½ and 1⅝th per cent. were inferior. German steel of poor quality (for springs) yet made a good magnet; it had little homogeneity, and consisted of an intimate mixture of iron, and iron cemented with a small proportion of carbon. A too-small proportion of carbon suppresses or weakens the remanent magnetism. M. Pictet also finds that the increase of magnetic power in a magnet through the mere presence of the armature in contact is a certain fact for some qualities of steel, but not for all. The first magnetic passes develop nearly the whole of the remanent magnetism in all artificial magnets. Detachment of the armature by the dynamometer seemed to have no action on the magnetic power, only the slipping of the armature when near rupture must be avoided.

AN experimental inquiry into the production of tones by passage of gases through slits is described by Herr Kohlrausch in *Wiedemann's Annalen* (No. 8). The principal results are these: (1) For all widths of slit between 0·2 mm. and 1 mm. and all densities of gas employed, the pitch n may be represented as linear function of the velocity of outflow u by the formula $n = k(u - u_0)$, where u_0 and k are constant for a given width of slit and variety of gas; (2) with increasing width of slit (0·2 mm. to 1 mm.) u_0 decreases, k increases; (3) u_0 and k (for air) are as good as independent of the thickness of the slit (*i.e.* the thickness of the brass plates forming it), from 1 mm. to 9 mm.; (4) with increasing density of gas (0·7 to 1·5) u_0 generally decreases, k increases, *i.e.* the tones, *ceteris paribus*, become higher; (5) u_0 and k depend in no small measure on other properties of gases besides density; (6) starting from wide slits with constant velocity of outflow, the pitch increases pretty uniformly with narrowing of the slit, reaches a maximum with widths between 0·35 mm. and 0·27 mm.—with thicker slits, smaller pressures, and less dense gases, sooner than in the opposite cases—and then decreases more and more quickly with the width of slit; (7) this maximum pitch characteristic for each velocity of outflow occurs with a greater width of slit, the less the velocity. From a comparison with Strouhal's experiments on the tones excited by motion of cylindrical bodies in air, the author concludes that the production of slit-tones is to be referred to like causes to those of wire-tones.

AN electrophotometer recently described by Dr. Nachs (*La Natura*, August 1) has the following arrangement:—A wooden case opening on one side and above is divided into two compartments, an upper and a lower. The lower contains in the inner part a dry pile of 200 elements, and in the outer a Jacobi rheostat, the cylinder of which has thirty windings (the number introduced into circuit by turning a handle is precisely indicated). The upper compartment has interiorly a galvanometer, and exteriorly an adjustable truncated cone with inner surface blackened, and within it a small selenium cell similar to those used by Bell and Tainter, to receive the light. This cell and the three other electrical instruments are connected by wire. The mode of action will be readily comprehended.

MR. MILNE has observed (*Zeits. f. Kryst.*) that if a suspended quartz ball be allowed to impinge in various ways upon a fixed ball of lime spar, or if the ball of lime spar be placed on a billiard table and the distance observed to which it is driven by the shock, in the former case the quartz ball rebounds furthest, and in the latter the lime spar ball is driven furthest, when the impulse is in the direction of the (crystalline) axes.

IN a paper to the Bremen Society of Natural Science, Herr Müller Erzbach describes experiments in which he sought to ascertain the relative tension of aqueous vapour over saturated solutions of different hygroscopic substances, the inclosed air being submitted for long periods to the action of these. 1. For saturated solutions one finds in the same series, soda, potash, chloride of calcium, an increase in the vapour-tensions, and a decrease in the contractions. 2. Phosphoric acid anhydride, concentrated sulphuric acid, and hydrate of potash deprived of water, present no essential difference in attraction of water. 3. Caustic soda and chloride of calcium, with small proportion of water, differ little in attraction of water, but they do not bind it so firmly as phosphoric acid or hydrate of potash. 4. Hydrate of soda can be completely deprived of water by inclosure with hydrate of potash. 5. The difference in tension of aqueous vapour over the anhydride of phosphoric acid and chloride of calcium nearly without water amounts to only a small fraction of a millimetre of mercury.

THE hypothesis that the luminiferous ether is at rest and the earth moves through it, has been lately put to experimental test by Mr. Michaelson of the U.S. Navy (*Amer. Journ. of Science*, August). Two pencils of light which have travelled over paths at right angles (one path being in the direction of the earth's motion) are permitted to interfere. On rotation of the apparatus 90° a measurable displacement, estimated at about one-tenth of the distance between the fringes, might be looked for (the author considered) if the hypothesis of a stationary ether were correct. The apparatus was first tried in the Physical Institute